**COURSE DESCRIPTION**

**Course Title:** AP Calculus AB

**Course Number:** 00292

**Course Prerequisites:** Completion of Pre-Calculus Honors or Pre-Calculus CP with an average of 80% or above

**Course Description:** AP Calculus AB is intended for all mathematics, engineering, and science students who want to further their fundamental knowledge of mathematics. This course is designed for students to study: Limits, Derivatives, Trigonometric Functions, the Integral, and applications of these ideas in various mathematics, science, and physics real-world problems. Students taking this course are preparing for the option of taking AP Calculus Exam. District mid-term assessment and final exam are required.

**Suggested Grade Level**: Grades 11-12

**Length of Course:** Two Semesters

**Units of Credit:** 1

**PDE Certification and Staffing Policies and Guidelines (CSPG) Required Teacher Certifications:**

CSPG #50 Mathematics (7-12)

To find the CSPG information, go to [CSPG](https://www.education.pa.gov/Educators/Certification/Staffing%20Guidelines/Pages/default.aspx)

**Certification verified by the WCSD Human Resources Department:** [x] Yes [ ] No

**WCSD STUDENT DATA SYSTEM INFORMATION**

**Course Level:** AP (1) GPA +10%

**Mark Types:** Check all that apply.

[x] F – Final Average [x] MP – Marking Period [x] EXM – Final Exam

**GPA Type**: [ ]  GPAEL-GPA Elementary [ ]  GPAML-GPA for Middle Level [x]  NHS-National Honor Society

[x]  UGPA-Non-Weighted Grade Point Average [x]  GPA-Weighted Grade Point Average

**State Course Code**: 02124

To find the State Course Code, go to [State Course Code](https://nces.ed.gov/forum/sced.asp), download the Excel file for *SCED*, click on SCED 6.0 tab, and choose the correct code that corresponds with the course.

**TEXTBOOKS AND SUPPLEMENTAL MATERIALS**

**Board Approved Textbooks, Software, and Materials:**

**Title:**  *Calculus AP Edition with CalcChat and CalcView, 11e*

**Publisher:** Cengage Learning

**ISBN #:**  978-1-337-28688-6

**Copyright Date:** 2018

**WCSD Board Approval Date:** 6/29/2020

**Supplemental Materials:** College Board: AP Classroom, Khan Academy, Kuta Software,
 pdesas.org, TI-89 Titanium Graphing Calculator

**Curriculum Document**

**WCSD Board Approval:**

**Date Finalized:** 5/23/2022

**Date Approved:**  6/13/2022

**Implementation Year:** 2022-2023

**SPECIAL EDUCATION, 504, and GIFTED REQUIREMENTS**

The teacher shall make appropriate modifications to instruction and assessment based on a student’s Individual Education Plan (IEP), Chapter 15 Section 504 Plan (504), and/or Gifted Individual Education Plan (GIEP).

**SCOPE AND SEQUENCE OF CONTENT, AND CONCEPTS**

**Marking Period 1: Summer Preparation for Calculus, Limits and Continuity, and Differentiation: Definition and Basic Derivative Rules**

* Summer Preparation for Calculus (Review/Assessment)
	+ Graphs and Models
	+ Linear Models and Rates of Change
	+ Functions and Their Graphs
	+ Trigonometric Functions Review
* Limits Graphically and Numerically
* Evaluation of Limits Analytically
* Continuity and One-Sided Limits
* Infinite Limits
* Limits of Infinity
* The Derivative and the Tangent Line Problem
* Basic Differentiation Rules and Rates of Change
* Product and Quotient Rules and Higher Order Derivatives
* The Natural Logarithmic Function: Differentiation
* Exponential Functions: Differentiation, Integration
* Marking Period 1

**Marking Period 2: Differentiation: Composite, Implicit, Inverse Functions,
Contextual Application of Differentiation, and Analytical Applications of Differentiation**

* The Chain Rule
* Implicit Differentiation
* Inverse Functions
* Inverse Trigonometric Functions: Differentiation
* Basic Differentiation Rules and Rates of Change
* Related Rates
* Differentials
* Indeterminate Forms and L’Hopital’s Rule
* Extrema on an Interval
* Rolle’s Theorem and the Mean Value Theorem
* Increasing and Decreasing Functions and the First Derivative Test
* Concavity and the Second Derivative Test
* A Summary of Curve Sketching
* Optimization Problems
* Mid-Term Review and Assessment

**Marking Period 3: Integration and Accumulation of Change, Differential Equations, and Applications of Integration: Average Value**

* Antiderivatives
* Area
* Riemann Sums and Definite Integrals
* The Fundamental Theorem of Calculus: Accumulation Functions
* Integration by Substitution
* The Natural Logarithmic Function: Integration
* Differentials
* Exponential Functions: Differentiation, Integration
* Bases Other Than e and Applications
* Slope Fields and Euler’s Method
* Separation of Variables and the Logistic Equation
* The Fundamental Theorem of Calculus: Average Value of Functions
* Marking Period 3

**Marking Period 4: Applications of Integration: Area, Volume, and AP Preparation and Exam**

* Area of a Region Between Two Curves
* Volume: The Disc and Washer Methods
* AP Calculus AB Preparation and Exam
	+ Limits and Continuity
	+ Differentiation: Definition and Basic Derivative Rules
	+ Differentiation: Composite, Implicit, and Inverse Functions
	+ Contextual Application of Differentiation
	+ Analytical Applications of Differentiation
	+ Integration and Accumulation of Change
	+ Differential Equations
	+ Applications of Integration
* Final Exam Review and Assessment
	+ Integration and Accumulation of Change
	+ Differential Equations
	+ Applications of Integration

**Standards/Eligible Content and Skills**

| **Performance Indicator** | **PA Core Standard and/or Eligible Content** | **Marking Period Taught**  |
| --- | --- | --- |
| Sketch the graph of an equation | CC.2.2.HS.D.7F-IF.7 | SP/MP1 |
| Find the intercepts of a graph | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Test a graph for symmetry with respect to an axis or the origin | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Find the points of intersection of two graphs | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Interpret mathematical models for real-life data | CC.2.2.HS.C.6CC.2.2.HS.D.10A-CED.3 | SP/MP1 |
| Find the slope of a line passing through two points | CC.2.2.HS.C.1 | SP/MP1 |
| Write the equation of a line with a given point and slope | A-CED.2 | SP/MP1 |
| Interpret slope as a ratio or as a rate in a real-life application | CC.2.2.HS.C.6A-SSE.1 | SP/MP1 |
| Sketch the graph of a linear equation in slope-intercept form | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Write equations of lines that are parallel or perpendicular to a given line | A-CED.2 | SP/MP1 |
| Use function notation to represent and evaluate a function | F-IF.2 | SP/MP1 |
| Find the domain and range of a function | F-IF.1 | SP/MP1 |
| Sketch the graph of a function | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Identify different types of transformations of functions | CC.2.2.HS.C.4 | SP/MP1 |
| Classify functions and recognize combinations of functions | CC.2.2.HS.C.4 | SP/MP1 |
| Describe angles and use degree measure | G-CO.1 | SP/MP1 |
| Use radian measure | F-TF.1 | SP/MP1 |
| Understand the definitions of the six trigonometric functions | F-TF.2 G-SRT.6 | SP/MP1 |
| Evaluate trigonometric functions | CC.2.2.HS.C.7 | SP/MP1 |
| Solve trigonometric equations | CC.2.2.HS.D.10 | SP/MP1 |
| Graph trigonometric functions | CC.2.2.HS.C.8F-IF.7 | SP/MP1 |
| Define a limit | A-SSE.1 | MP1 |
| Use limit notation | A-SSE.1 | MP1 |
| Estimate limit values from graphs | CC.2.2.HS.C.6A-REI.11F-IF.4 | MP1 |
| Estimate limit values from tables | CC.2.2.HS.C.6A-REI.11F-IF.4 | MP1 |
| Determine limits using algebraic properties of limits | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Determine limits using algebraic manipulation | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Select procedures for determining limits | CC.2.2.HS.C.1 | MP1 |
| Determine limits using the Squeeze Theorem | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Connect multiple representations of limits | CC.2.2.HS.D.7 | MP1 |
| Explore different types of discontinuities | CC.2.2.HS.D.7 | MP1 |
| Define continuity at a point | CC.2.2.HS.D.7 | MP1 |
| Confirm continuity on an open interval | CC.2.2.HS.D.7 | MP1 |
| Remove discontinuities | CC.2.2.HS.D.7 | MP1 |
| Connect infinite limits and vertical asymptotes | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Connect limits at infinity and horizontal asymptotes | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Work with the Intermediate Value Theorem (IVT) | CC.2.2.HS.C.1 | MP1 |
| Define average and instantaneous rates of change at a point | CC.2.2.HS.C.1F-IF.6 | MP1 |
| Define the derivative of a function | CC.2.2.HS.C.1F-IF.2 | MP1 |
| Use the derivative function | CC.2.2.HS.C.1 | MP1 |
| Estimate derivatives of a function at a point | CC.2.2.HS.C.1A-REI.11 | MP1 |
| Connect differentiability and continuity – when derivatives do and do not exist | CC.2.2.HS.C.1 | MP1 |
| Apply the Power Rule | CC.2.2.HS.C.1 | MP1 |
| Use the derivative rules: Constant, Sum, Difference, Constant, Multiple | CC.2.2.HS.C.1 | MP1 |
| Find the derivatives of cos x, sin x, ex, and ln x | CC.2.2.HS.C.6 | MP1 |
| Use the Product Rule | CC.2.2.HS.C.1 | MP1 |
| Use the Quotient Rule | CC.2.2.HS.C.1 | MP1 |
| Find the derivative of tangent, cotangent, secant, and/or cosecant functions | CC.2.2.HS.C.6 | MP1 |
| **Marking Period 1 - Ends**  |  | MP1 |
| Use the Chain Rule | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Use implicit differentiation | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Differentiate inverse functions | F-BF.4 | MP2 |
| Differentiate inverse trigonometric functions | F-BF.4 F.TF.7 | MP2 |
| Select procedures for calculating derivatives | CC.2.2.HS.C.6 | MP2 |
| Calculate higher-order derivatives | CC.2.2.HS.C.1 | MP2 |
| Interpret the meaning of the derivative in context | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP2 |
| Connect position, velocity, and acceleration – straight-line motion | F-IF.6 | MP2 |
| Use rates of change in applied context other than motion | F-IF.6 | MP2 |
| Set up related rates problems | F-IF.6 | MP2 |
| Solve related rates problems | F-IF.6 | MP2 |
| Approximate values of a functions using local linearity and linearization | CC.2.2.HS.C.1A-REI.11 | MP2 |
| Use L’Hopital’s Rule for determining limits of indeterminate forms | CC.2.2.HS.C.1 | MP2 |
| Use the Mean Value Theorem | CC.2.2.HS.C.1 | MP2 |
| Use the Extreme Value Theorem | CC.2.2.HS.C.1 | MP2 |
| Find global extrema, local extrema, and critical points | F-IF.4 | MP2 |
| Determine intervals on which a function is increasing or decreasing | F-IF.4 | MP2 |
| Use the First Derivative Test to determine relative/local extrema | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Use the Candidates Test to determine absolute/global extrema | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Determine concavity of functions over their domains | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Use the Second Derivative Test to determine extrema | CC.2.2.HS.C.1 | MP2 |
| Sketch graphs of functions and their derivatives | CC.2.2.HS.C.2F-IF.7 | MP2 |
| Connect a function, first derivative, and a second derivative | CC.2.2.HS.C.5 | MP2 |
| Set up optimization problems | CC.2.2.HS.C.1 | MP2 |
| Solve optimization problems | CC.2.2.HS.C.1 | MP2 |
| Explore behaviors of implicit relations | F-IF.4 | MP2 |
| **Mid-Term Review and Assessment** |  | MP2 |
| * Review and extend knowledge of Limits and Continuity
 |  | MP2 |
| * Review and extend knowledge of Differentiation: Definitions and Basic Derivative Rules
 |  | MP2 |
| * Review and extend knowledge of Differentiation: Composite, Implicit, Inverse Functions
 |  | MP2 |
| * Review and extend knowledge of Contextual Application of Differentiation
 |  | MP2 |
| * Review and extend knowledge of Analytical Applications of Differentiation
 |  | MP2 |
| Explore accumulations of change | F-IF.6 | MP3 |
| Approximate Riemann Sums | CC.2.2.HS.C.1 | MP3 |
| Use Riemann Sums, summation notation, and definite integral notation | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP3 |
| Use the Fundamental Theorem of Calculus with accumulation functions involving area | CC.2.2.HS.C.2CC.2.3.HS.A.14 | MP3 |
| Interpret the behavior of accumulation functions involving area | CC.2.2.HS.C.2CC.2.3.HS.A.14 | MP3 |
| Apply properties of definite integrals | CC.2.2.HS.C.2 | MP3 |
| Use the Fundamental Theorem of Calculus with definite integrals | CC.2.2.HS.C.4 | MP3 |
| Find the antiderivatives and indefinite integrals using basic rules and notation | CC.2.2.HS.C.6 | MP3 |
| Integrate using substitution | A-SSE.3 | MP3 |
| Integrate functions using long division and completing the square | A.APR.6A-SSE.3F-IF.8A | MP3 |
| Select techniques for antidifferentiation | CC.2.2.HS.C.6 | MP3 |
| Model situations with differential equations | CC.2.2.HS.C.2 | MP3 |
| Verify solutions for differential equations | CC.2.2.HS.C.9 | MP3 |
| Sketch slope fields | CC.2.2.HS.C.5F-IF.7 | MP3 |
| Reason using slope fields | CC.2.2.HS.D.9 | MP3 |
| Find general solutions using separation of variables | CC.2.2.HS.D.10 | MP3 |
| Find particular solutions using initial conditions and separation of variables | CC.2.2.HS.D.10 | MP3 |
| Model exponentials with differential equations | CC.2.2.HS.D.6A-SSE.3C | MP3 |
| Find the average value of a function on an interval | CC.2.2.HS.C.1 | MP3 |
| Connect position, velocity, and acceleration of functions using integrals | CC.2.2.HS.C.1 | MP3 |
| Use accumulation functions and definite integrals in applied contexts | CC.2.2.HS.C.1 | MP3 |
| **Marking Period 3 - Ends** |  | MP3 |
| Find the area between curves expressed as functions of x | CC.2.3.HS.A.14 | MP4 |
| Find the area between curves expressed as functions of y | CC.2.3.HS.A.14 | MP4 |
| Find the area between curves that intersect at more than two points | CC.2.3.HS.A.14 | MP4 |
| Find the volume with cross sections of squares and rectangles | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume with cross sections of triangles and semicircles | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the disc method revolving around x- or y-axis | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the disc method revolving around other axes | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the washer method revolving around the x- or y-axis | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the washer method revolving around other axes | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| **AP Exam Review and Exam** |  | MP4 |
| * Review and prepare knowledge of Limits and Continuity
 |  | MP4 |
| * Review and prepare knowledge of Differentiation: Definition and Basic Derivative Rules
 |  | MP4 |
| * Review and prepare knowledge of Differentiation: Composite, Implicit, Inverse Functions
 |  | MP4 |
| * Review and prepare knowledge of Contextual Application of Differentiation
 |  | MP4 |
| * Review and prepare knowledge of Analytical Applications of Differentiation
 |  | MP4 |
| * Review and prepare knowledge of Integration and Accumulation of Change
 |  | MP4 |
| * Review and prepare knowledge of Differential Equations
 |  | MP4 |
| * Review and prepare knowledge of Applications of Integration
 |  | MP4 |
| **Final Exam Review and Assessment** |  | MP4 |
| * Review and extend knowledge of Integration and Accumulation of Change
 |  | MP4 |
| * Review and extend knowledge of Differential Equations
 |  | MP4 |
| * Review and extend knowledge of Applications of Integration
 |  | MP4 |

**ASSESSMENTS**

**PDE Academic Standards, Assessment Anchors, and Eligible Content:** The teacher must be knowledgeable of the PDE Academic Standards, Assessment Anchors, and Eligible Content and incorporate them regularly into planned instruction.

**Formative Assessments:** The teacher will utilize a variety of assessment methods to conduct in-process evaluations of student learning.

**Effective formative assessments for this course include:
Suggested but not limited to:**

* Pre-assessments of prior knowledge (e.g., Entrance cards or KWL chart)
* Bellringers/Problems of the Day (PODs)
* Discussions
* Exit ticket
* Teacher observations/Questioning
* Graphic organizers (e.g., Venn Diagrams, word mapping, webbing, KWL chart, etc.)
* Outlining
* Cooperative learning
* Written work
* Quizzes
* Oral response
* Self-evaluation
* Homework
* Summarizing
* Note-taking

**Summative Assessments:** The teacher will utilize a variety of assessment methods to evaluate student learning at the end of an instructional task, lesson, and/or unit.

**Effective summative assessments for this course include:
Suggested but not limited to:**

* Performance assessment
* Chapter/unit tests
* Quizzes
* Mid-Term exam
* Final exam
* Projects
* Student presentations